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Visual mapping of team dynamics and communication patterns on surgical ward rounds: an ethnographic study

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► Additional material is published online only. To view, please visit the journal online (http://dx.doi.org/10.1136/bmjqs-2020-012372).

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Received 14 September 2020
Revised 3 December 2020
Accepted 19 January 2021

To cite: Bonaconsa C, Mbamalu O, Mendelson M, *et al*. *BMJ Qual Saf* Epub ahead of print: [please include Day Month Year]. doi:10.1136/bmjqs-2020-012372

ABSTRACT

Background The effect of team dynamics on infection management and antimicrobial stewardship (AMS) behaviours is not well understood. Using innovative visual mapping, alongside traditional qualitative methods, we studied how surgical team dynamics and communication patterns influence infection-related decision making.

Materials/methods Between May and November 2019, data were gathered through direct observations of ward rounds and face-to-face interviews with ward round participants in three high infection risk surgical specialties at a tertiary hospital in South Africa. Sociograms, a visual mapping method, mapped content and flow of communication and the social links between participants. Data were analysed using a grounded theory approach.

Results Data were gathered from 70 hours of ward round observations, including 1024 individual patient discussions, 60 sociograms and face-to-face interviews with 61 healthcare professionals. AMS and infection-related discussions on ward rounds vary across specialties and are affected by the content and structure of the clinical update provided, consultant leadership styles and competing priorities at the bedside. Registrars and consultants dominate the discussions, limiting the input of other team members with recognised roles in AMS and infection management. Team hierarchies also manifest where staff position themselves, and this influences their contribution to active participation in patient care. Leadership styles affect ward-round dynamics, determining whether nurses and patients are actively engaged in discussions on infection management and antibiotic therapy and whether actions are assigned to identified persons.

Conclusions The surgical bedside ward round remains a medium of communication between registrars and consultants, with little interaction with the patient or other healthcare professionals. A team-focused and inclusive approach could result in more effective decision making about infection management and AMS.

INTRODUCTION

The surgical pathway (before, during and after surgery) is a complex network of teams and processes working towards optimising patient care and clinical outcomes. To date, the emphasis on infection management in this pathway has had a narrow perspective, focusing on improving surgical antibiotic prophylaxis and reducing surgical site infections.[1 2] Recent data have described the impact of the cultural, behavioural and contextual determinants that influence clinicians and their actions in preventing and managing infections in surgery.[3–6] Key healthcare workers (HCWs), at different points in the pathway, have roles in antimicrobial stewardship (AMS) and infection prevention and control (IPC).[7] The emerging data call for greater integration of roles across disciplines as well as more effective coordination and communication between surgical team members.

The surgical ward round is central to the patient's journey in the hospital,[8] providing a daily opportunity for clinical review of patients to inform decision making.[9] The ward round provides an opportunity for clinical updates and discussions on infection diagnosis and treatment.[10] The quality of teamwork and collaboration on ward rounds has been associated with patient outcomes[10–15] with poor quality ward rounds reported to place patients at up to a sixfold risk of developing preventable complications.[9] Ward rounds are a complex process for HCWs and patients to navigate.[16–18] Some of the complexities include the

lack of a standard definition of what a ward round should be, inconsistent attendance, unstructured or non-standardised handover formats, and divergent role expectations and time pressures that can create the potential for important aspects of care to be overlooked.[5 6 16 19 20]

Poor communication in healthcare remains a primary contributor to adverse events that compromise patient safety.[21 22] Numerous studies report on the gaps in care resulting from lapses in the quality and effectiveness of communication on ward rounds[23 24] as well as information transfer failures across the entire surgical care pathway.[19] Qualitative methods, including ethnography, have described the influence of social, behavioural and contextual factors on team communication, especially as it relates to the complexity of decisions on AMS and IPC.[5 6] These studies have identified the hierarchies in decision making, which may shape involvement in and deliberation of antibiotic prescribing and IPC behaviours. Much of the data generated for these findings is collected from direct observations of ward rounds. Ward rounds, like many other normative clinical practices, are daily events that exist 'in plain sight', where complexities of practices are taken for granted and remain invisible to involved role players.[24] Gathering real-time data on team dynamics and communication aimed at providing in-depth contextual insights to inform health interventions remains difficult.[25] To effectively map the communication process and how it impacts clinical decision making across teams and disciplines, alternative approaches such as the use of video reflexive ethnography and self-reflection by team members have been applied.[26 27] North *et al*[28] offers one of the few descriptions from a hospital setting where interactions between health professionals and families, aimed at making patterns of communication visible, are recorded in real time. They employ an innovative visual mapping tool, the sociogram, which uses visual illustrations to represent communication networks in a group.[29–33] In addition to other visual participatory and qualitative methods, they describe team communication practices that provide insight into families' involvement in the care of their hospitalised children. Various forms of sociograms have been used in healthcare to investigate team behaviours,[34] patterns and methods of communication across teams,[13 35 36] and in focus groups.[37] They can be tailored to highlight the topics of discussion and to reflect the density of interaction between different participants. When applied to the ward round, sociograms enable the visual representation of participants' positions and verbal contributions during consultations. In this study, we applied the method of the hand-drawn directed sociogram[30] to capture and record ward rounds in real time, investigating aspects of communication and team dynamics related to AMS and IPC across selected surgical teams.

METHODS

Study design

An ethnographic study comprising non-participant observations of ward rounds and semistructured interviews with HCWs was conducted. Sociograms were used to map IPC and AMS focused communication patterns and team dynamics at the patient bedside.

Setting

This study was conducted across the cardiothoracic (specialty A), gastrointestinal (GI) acute care (specialty B) and GI colorectal (specialty C) surgical units at a 950-bedded tertiary public and government-funded referral university hospital in Cape Town, South Africa. The teams were chosen to reflect specialties undertaking high infection risk surgical procedures.

Data collection

All healthcare professionals involved in patient care in the included specialties were eligible to participate in the study. Site access was made possible via the principal investigator at the study site (MM) who, through purposive sampling, identified the key stakeholders. Through a series of face-to-face briefings, the study was introduced to the leads within the specialties. Written informed consent was obtained from all consultants at these meetings, with a follow-up email sent to their teams. Prior to the start of the study, posters and information sheets were placed on notice boards in the participating units. Additionally, on each episode of ward round observation, the researchers introduced themselves to any new HCW present, and verbal consent for participation was obtained. Patients were not included as study participants. No data were gathered from patients. The only occasion where patients were included in this study was during the bedside conversations with the teams, and on these occasions, no identifiable or personal data from patients were gathered.

Ethnographic observations

Between May and November 2019, researchers (CB, OM and EC) conducted ethnographic observations on consultant-led morning ward rounds. Field notes recorded interactions related to antibiotic use and IPC around the patient's bedside, as well as communication patterns between those present. A data collection guide, developed through a review of the literature and previous work of the research team in the UK,[5] was used to gather data. Documentary analysis of patient records and the local hospital policy and guidelines on antibiotic prescribing were reviewed to provide additional knowledge of the existing policies, guidelines and processes.

Sociograms of encounters at the patient bedside

Sociograms were captured (by CB and OM) on two consultant-led ward rounds per week from the cardiothoracic intensive care unit (ICU), GI acute care and colorectal surgical units between September and October 2019. A pilot phase, conducted during the month of August, included data collection from a series of ward rounds to test, refine and adjust the methods, resulting in a tailored approach to drawing sociograms that could fully represent interaction on ward rounds. While the sociograms included broad aspects of communication, for the purpose of the study, we have selected sociograms that focused on communication relevant to AMS and IPC.

Interviews

A purposive sample of HCWs involved in patient care were invited to participate in face-to-face interviews. The semistructured interviews were conducted in English (by CB, OM and EC) and explored HCWs' perception and understanding of their roles and experiences in relation to AMS and IPC. Written informed consent was obtained from each participant prior to interview. Interviews were audio-recorded and transcribed verbatim.

Data analysis

Iterative data analysis, drawing on elements of grounded theory,[38] explored themes and relationships within the data collected, aided by NVivo V.12 software. The coding framework was developed iteratively. Three researchers (CB, OM and EC) began by each independently coding the same subset of data and comparing the coding, and through regular discussion and consensus, developing a draft framework of the emerging themes. This framework was then used to code the remaining data. Any additions to the framework were made after discussion and agreement. Constant comparison enabled within-narrative and between-narrative comparison of the emerging data and the identification of key themes.[5 39] The coding framework was kept broad to include emerging codes on all aspects of infection-related care. This included codes on the level of participation, discussions and identification of tasks on the ward rounds. Cross-cutting themes relevant to communication on infection management and AMS were identified within the framework. The findings were then discussed with the remaining authors through a series of meetings.

The themes identified through the qualitative framework allowed for contextual analysis of the sociogram data. Initiators and recipients actively engaged in conversation related to antibiotic management and IPC were identified. Sociograms were interrogated to extract the count and topic of individual interactions initiated by ward round attendees. Communication episodes were itemised and quantified into variables. Descriptive statistics were used to analyse the data by specialty for a number of variables: initiators of communication (category of HCW), recipients of communication (category of HCW) and topics of communication (eg, antibiotic therapy, other clinical interventions, diagnostic tests including culture and sensitivity, lines and invasive devices and infection markers). Frequency tables compared means between patient bedside consultations and across specialties. Data visualisation techniques and charts on Microsoft platforms were used to illustrate and quantify the sociograms.

RESULTS

The results presented are derived from analysis of field notes, interview data, documents and sociograms. We conducted 70 hours of observations, including 1024 individual patient bedside consultations (ward round demographics table, online supplemental file 1). Sixty-one HCWs from surgical specialties, ICUs, AMS team members and nursing teams were interviewed (full interview participant list, online supplemental file 2). Sixty sociograms (20 from each specialty), mapping communication and interaction on topics related to infection management and AMS between ward round attendees, were included. We outline the nature of surgical ward rounds, then describe three overarching themes: communication flow, consistency of focus and consultant leadership style, and identify how these impact on approaches to preventing and managing infections, and AMS.

The surgical ward round and infection management

Across the specialties, morning ward rounds are conducted from 07:30 and are led by senior consultants who assume oversight and responsibility for patient care. Working under supervision of consultants, registrars (also known as residents or surgical trainees) respond to suspected infections in newly admitted or longer stay inpatients and commence empiric antibiotic therapy where necessary (Q1, Q2, table 1). Consultants are informally (through instant messages and phone calls) consulted for specific queries throughout the day. The morning round, varying in attendance, duration and the number of patients seen (ward round demographics table, online supplemental file 1) remains a platform where the wider team review and make key decisions on antibiotic prescribing and infection prevention and management. Regular contact with the microbiology laboratory via telephone or smartphone applications help guide infection diagnosis and targeted antibiotic therapy (Q3, table 1).

An example of a sociogram illustrating the pattern of communication related to infection management and AMS on the ward round is provided in figure 1, with an accompanying description. This sociogram demonstrates interactions about antibiotic prescribing and microbiological culture results among the team members where the consultant decides on

Table 1 The key emerging themes from interviews and observations across the cardiothoracic, gastrointestinal acute care and colorectal surgery teams

Theme	Quotes **(normal text denotes observation notes, italics denotes quotes from participants)**
The surgical ward round and infection management	**Quote 1** *Usually the registrars (prescribe empiric antibiotics), because they see the patients first. But if they haven't started treatment, we will give input when they present the patient to us on the round or during the day. I always check that they started appropriate treatment*. Interview, GI surgeon (42) specialty B **Quote 2** *The registrar presents the patients to us. Mostly we know the patients already but will confirm or make new decisions on the round*. Interview, GI surgeon(26) specialty B **Quote 3** *We have a very good relationship with our microbiologist. We have open communication with microbiology and infectious diseases. We seldom start something ad-hoc without discussing it and will correlate the clinical evidence or information with the microbiological evidence available to us. My impression is that in most cases we will discuss it*. Interview, ICU consultant (58) specialty A
Flow of communication about AMS and infection management is primarily between consultants and registrars	Quote 4 *One of the big issues we have is the availability of some of the antibiotics after hours. In wards like casualty and theatre, they have most of the antibiotics they need. In our ward, we don't have this stock and the medical intern must fetch it from the emergency cupboard, which sometimes just doesn't happen*. Interview, GI surgeon (27) specialty B **Quote 5** *The wards have a 'cold cover' intern who covers all the surgical wards at night. They're putting in drips and resuscitating people. If you phone them and say that a patient needs a drip for antibiotics, and he's (intern) got fifteen others who also need antibiotics, your drip happens two-and-a-half hours later. If the intern still needs to fetch medication from the emergency cupboard amidst the other tasks … things just lag and eventually you've missed a dose*. Interview, GI surgeon (27) specialty B **Quote 6** *Time is very important when it comes to administration. The sooner I administer the antibiotics, the quicker it will do its work.* Interview, nurse (47) specialty A **Quote 7** *Some of the doctors will come to you and say: 'Sister, we have commenced the patient on this medication (antibiotics)'. Then you are aware of it. However, others will just write it up on the medication chart. This creates a bit of a challenge because we (nurses) need to be informed when something new (antibiotics) is prescribed*. Interview, nurse (43) specialty A **Quote 8** *Sometimes things fall through the cracks and you get there the next day and they (nurses) did not see the antibiotic charts and the antibiotics have not been administered*. Interview, GI surgeon (26) specialty B
Consistency of focus on AMS and infection management vary across specialties	**Quote 9** *That's just because, if you look at the leading cause of death internationally, it's sepsis. If you want to offer the patients the best chance you can, you've got to be good at managing and eliminating sepsis. The key to good critical care is the key to good infection control, good antibiotic stewardship, diagnosis, and management of sepsis. That's what makes or breaks it for the patients, mostly*. Interview, ICU consultant (58) specialty A **Quote 10** In the update the registrar mentions that the patient was started on amikacin for a resistant infection (*Proteus mirabilis* on tissue culture and *Acinetobacter spp*). Further details include that the *Proteus* is sensitive to meropenem while the *Acinetobacter* is resistant - microbiology have suggested to continue with amikacin. The lead consultant clarifies, 'So there is a pan-resistant bug but Colistin may be an option, though we are not sure yet?' The consultant reviews the prescription chart while the update continues and then asks: 'Is this dose of meropenem right since his renal function is now resolved? I would have thought 2 g *tds (three time a day)* to aid tissue penetration? The usual dose is 1 g 8-hourly but for resistant bugs and to aid tissue penetration or meningitis, we can do 2 g 8-hourly. Can we check with Microbiology?' Observation notes, specialty A **Quote 11** In the update the registrar summarises the main concerns over the past 24 hours, including the pus in the wound, reporting that a pus swab was taken. Further information includes details on the patient's vital signs and neurological status, electrolytes, intake and output as well as the intercostal drains. The patient has a fever and raised white cell count. A blood culture result is pending. The presenting registrar states that the plan is to do a tracheal aspirate and to follow up with microbiology. A senior registrar suggests that they should remove the intercostal drain. The presenting registrar looks at the senior surgeon who nods in agreement and the lead ICU consultant says, 'Yes, I agree'. The ICU consultant looks to the whole group and asks if they agree with the plan. Observation notes, specialty A **Quote 12** The registrar presents that the patient is hemodynamically stable after surgery. The consultant suggests that she would like to see the wounds. Together, the consultant, intern and registrar lift the sheets. The legs are bandaged, and the consultant asks the nurse to open the dressing after the round. The consultant asks whether the patient is on antibiotics and registrar replies that she is on oral amoxicillin/clavulanic acid because she had 'bad cellulitis'. The consultant concludes with the plan to continue antibiotics and remove the intravenous catheter. She also suggests referral to physiotherapy to assist with mobilisation. Observation notes, specialty B **Quote 13** The consultant greets the patient, holding the patient's left hand in hers as the intern provides the update. The patient complains of pain and the consultant checks the patient's dressing. The consultant turns to face the intern and questions the nature of the recent blood tests conducted. On receipt of information to the effect that the patient's creatinine and white cell count were checked, the consultant requests a full blood count including urea and electrolytes. The intern jots down the request. The consultant concludes that the patient should be started on amoxicillin/clavulanic acid, adding that she's concerned there might be a 'leak'. Observation notes, specialty B

Continued

Table 1 Continued

Theme	Quotes **(normal text denotes observation notes, italics denotes quotes from participants)**
Consultant leadership styles influence ward round dynamics and inclusivity in communication about AMS and infection management	**Quote 14** *Yes, we emphasise the importance of timely antibiotic administration on our ward rounds. You have to make eye contact with someone and say: 'Make sure this happens'*. Interview, surgeon (42) specialty B **Quote 15** The consultant asks the patient what he knows about his illness and if he has enough medicines. The patient describes what he understands about the condition and then says said that he 'only' has the antibiotics and feels better when he takes them. The consultant gently asks the patient to clarify what he means. After the patient provides an explanation, the consultant explains that the medication is not an antibiotic but is purposed to treat an ulcer. The consultant re-iterates the purpose and dose of the medication to the patient. Observation notes, specialty B **Quote 16** The patient had a temperature spike of 38.8 degrees. The consultant asks the patient if he has a burning sensation on urination to which the patient says 'no'. The consultant then looks at the wound and asks if the patient is on antibiotics to which the second consultant replies 'yes'. Turning to the patient, the consultant explains the reason for the temperature spike and re-assures the patient that s(he)is already receiving antibiotics but emphasises the importance of identifying the cause of the infection. Observation notes, specialty B

AMS, antimicrobial stewardship.

treatment. Individually, each sociogram provides an effective overview of the flow and type of communication during one patient bedside interaction. Collectively, the sociograms provide data on frequency and patterns of communication across the team. Figure 2 provides additional examples of sociograms that will be discussed throughout the results.

Emerging themes

Flow of communication about AMS and infection management is primarily between consultants and registrars

The surgical bedside ward round, though attended by different professionals (ward round demographics table, online supplemental file 1), remains primarily a medium of communication between consultants and registrars with little interaction with the patient or other healthcare professionals. Registrars act as gatekeepers and present patient updates that can include investigations and the outcomes that lead to infection management discussions in some cases; consultants guide discussions and are key decision makers (table 2). The hierarchy in flow of communication around the patient bedside is evident when the sociogram data on frequency, direction and type of communication is tracked to the individual actors (figure 3). Although numbers of ward round participants vary, the hierarchy of communication remains mostly the same across specialties. Nurses and other non-surgical HCWs are seldom actively engaged in discussions. They are not expected to make contributions or provide feedback on antibiotic or infection management, despite having explicit and ongoing roles in the infection management of the patients under discussion. High patient numbers and suboptimal nurse-to-patient ratios mean that nurses in some settings are more likely to juggle priorities, miss parts of ward rounds and often rely on surgical interns to fill the gaps in ensuring patients get their medication (Q4, Q5, table 1). New plans initiated by the consultant on antibiotic or infection management, such as de-escalating antibiotic therapy or removal of a peripheral intravenous catheter (which are tasks actioned by nurses) are communicated broadly to the group or the registrar providing the update. Direct communication between doctors and nurses, however, is a pivotal contributor to time-sensitive antibiotic administration. New antibiotic orders are likely to be written up at any time of the day in response to a new infection or when laboratory results become available. Although nurses are aware of the implications of timely antibiotic administration (Q6, table 1), they report that written up orders that are not directly communicated with them could delay administration of antibiotics by as much as a day (Q7, Q8, table 1).

Nurses, generally, physically position themselves on the outside of the group formed by consultants, registrars and interns, meaning they are sometimes out of audible range to clearly hear all communication and may miss some of the plans (figures 1 and 2 – sociograms 1 and 3). More importantly, HCWs' positions on the ward round may influence their input into discussions. Examples of inclusive team dynamics were noted during the smaller weekly ward rounds in one specialty where nurses positioned themselves more centrally in the ward rounds and actively engaged in discussions relating to the patient under their care (figure 2 – sociogram 4).

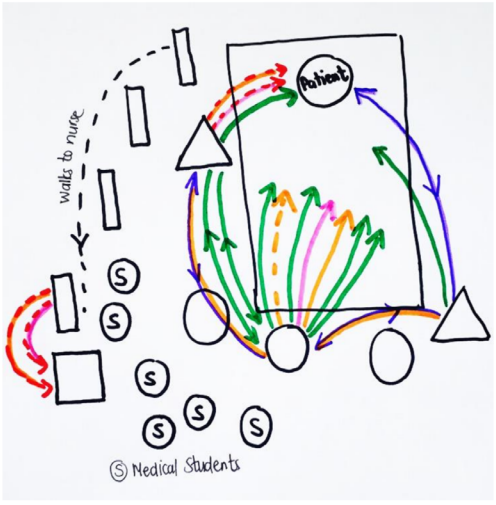
Consistency of focus on AMS and infection management vary across specialties

In the study hospital, patient records are paper based, and formal handover tools or sheets to guide structured handover are not in use. Details provided in the initial update by registrars on infection management and AMS vary in consistency. Observed communication patterns highlight possible gaps in the emphasis placed on infection priorities across different specialties. Routine inclusion of factors pertinent to infection management in the update is standard practice in specialty A. This is evidenced by the relatively

In this study, sociograms were used to capture and describe team dynamics and communication between attendees on consultant led surgical ward rounds. Guided by this inquiry and through direct observations of discrete episodes of care, the researchers identified communication themes pertinent to antibiotic prescription and infection management (see Colour key below). To enable the clear mapping of communication between role players, each communication theme was allocated a coloured arrow; categories of HCWs on the surgical team were assigned a symbol (see Symbol key below). In this study, a single arrow is a unit of communication and represents a sentence or a cluster of sentences around a specific concept. The direction of the arrow indicated who initiated the communication (initiator) and who it was directed at (recipient).

During the morning ward round, a sociogram captured all communication at the patient's bedside during a single/individual patient handover. As the team gathered around the patient's bed, the ward round participants were plotted according to their position around the bed space. As the handover commenced, the researcher recorded each episode of communication/speech using arrows.

An example of a sociogram illustrating team communication



Colour Key (Communication themes)

- Culture and sensitivity
- Infection markers
- Antibiotics
- Lines/ invasive devices/ wounds
- Asking questions
- Instruction
- Plan
- Other clinical information

Symbol key (Healthcare category)

- Consultant
- Nurse
- Registrar
- Intern

Description of communication captured by sociogram

In this example of a sociogram capturing the communication flow between HCWs on a consultant ward round, there are two senior consultants (triangles), three registrars (circles), three medical interns (rectangles), a student nurse (square) and six final year medical students. The presenting registrar, who stands near the bottom of the bed, provides a patient update, which includes details on **infection markers** (dotted orange arrow), empirical **antibiotic** therapy (pink arrow) and a pending **culture** result (orange arrow). Engaging the intern, the presenting registrar **initiates request** for an update on the pending **culture and sensitivity** results (purple/orange arrow). The consultants **initiate communication with patient**. The consultant and the registrar discuss the infection between themselves, including the pending **culture and sensitivity** results.
The second consultant engages the presenting registrar about **non-infection related concerns** (green arrows, *other clinical information*). The intern initiates communication with the student nurse, who stands at the fringes, repeating the **plan** that was communicated by the consultant to the patient (dotted red/ pink arrow; dotted red/ orange arrow). This illustrates the pervasive hierarchies in communication, even when the entire team is present.

Figure 1 Sociogram mapping the communication flow between healthcare workers on a consultant ward round.

even proportions of infection management topics reported by the registrar in figure 3. The clinical leadership in this specialty prioritises AMS and infection management as central to patient care (Q9, table 1 and figure 2 – sociogram 1). Although updates vary in content and detail provided on IPC and AMS, decisions are driven by the consultants (figure 1 - sociograms and figure 3). In specialty B and C, the risk of developing healthcare-associated infection (HCAI) due to prolonged insertion of central or peripherally inserted venous catheters is higher, and hence removal of unnecessary venous catheters and devices are prioritised on the ward round – driven by consultants.

Table 2 charts the count of contribution made by HCW category (eg, consultant, registrar and nurse) during handovers for patients prescribed antibiotics. The consultant's contribution is characterised by a relatively high proportion of questions and a positive reference to one or more topics broadly covering antibiotics, invasive devices and bacterial cultures and sensitivities. However, many key topics of infection management, for example, inflammatory markers, culture and sensitivity results, are excluded unless explicitly asked about by the consultants.

More comprehensive updates provide a platform to clarify, confirm and generate discussions on infection diagnosis and treatment (Q10, Q11, table 1). The consultants, through directed questions, lead the discussion and the quantity and quality of information presented by the registrar. Through specific questions related to infection management, the consultants have the potential to ensure that relevant infection-related

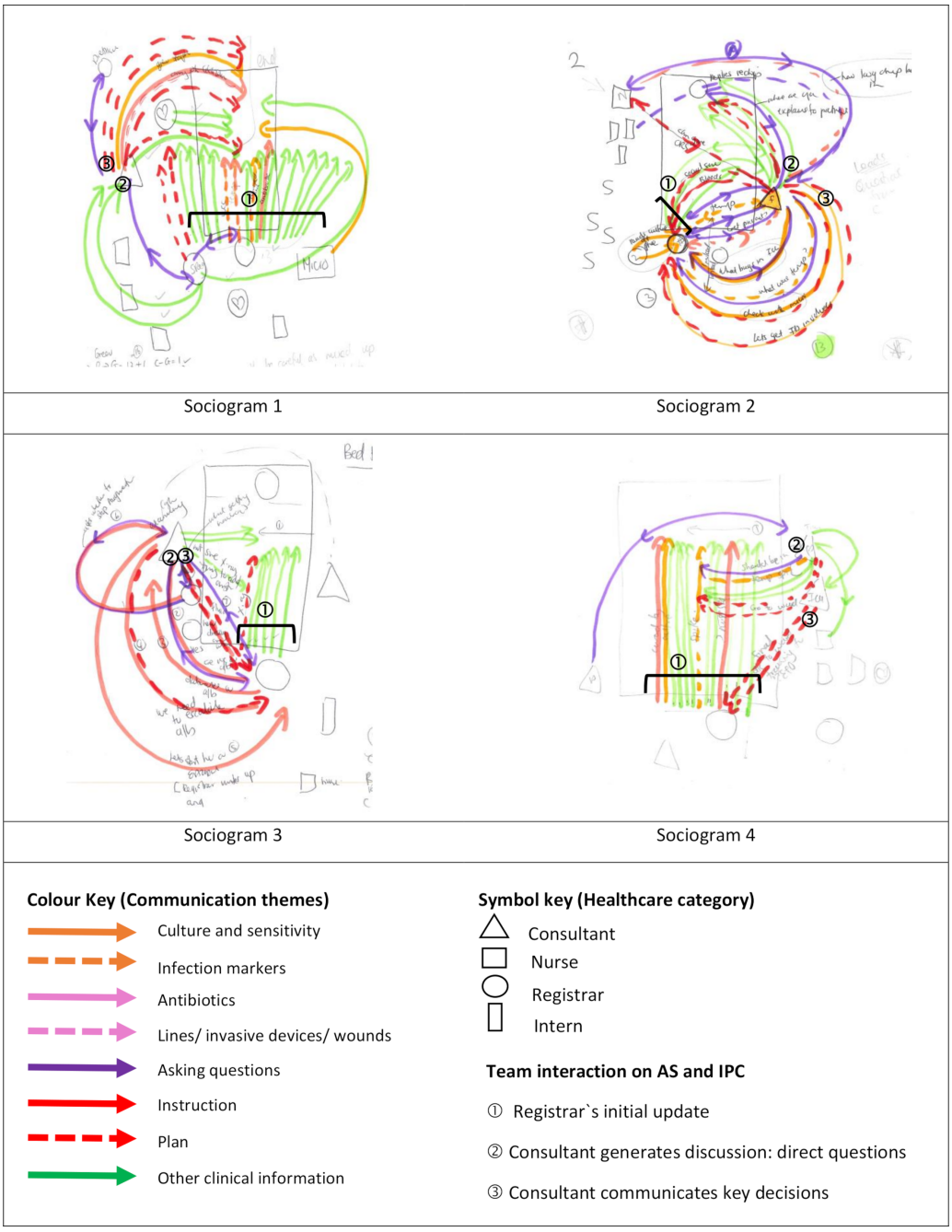


Figure 2 Sociograms illustrating communication flow between healthcare workers on a bedside ward round. AS, antibiotic stewardship; IPC, infection prevention and control.

points for patients are discussed and actions are identified (Q12, Q13, table 1, and figure 2 – sociograms 2 and 3).

The inconsistent approach to discussing key aspects pertinent to infection prevention and management mean that important details may be lost or become interspersed in other patient related surgical details. While discussions on infection management undoubtedly do take place for patients with an active or difficult to treat infection, in the time-sensitive context of the ward round, antibiotic de-escalation and removal of venous or urinary catheters may not be prioritised and therefore are less likely to be addressed if they were not directly linked to a new infection or raised in the initial update by the registrar.

Consultant leadership styles influence ward round dynamics and inclusivity in communicating about AMS and infection management

Leadership styles of the consultant leading the rounds impact on ward round dynamics. Team-focused consultants facilitate intentional and active engagement with the patients and the wider ward round teams. On these occasions, actions are more likely to

Table 2 Summary of frequency, direction and type of communication across specialties

	Initiators	Consultant								Other						Registrar						
Communication flow	Recipients	Consultant	Group	Intern	Nurse	Other	Patient	Registrar	Total N (%)	Consultant	Group	Nurse	Patient	Registrar	Total N (%)	Consultant	Group	Intern	Patient	Registrar	Total N (%)	Grand total
Antibiotic and infection prevention and management discussions	**Antibiotics**	**4**	**5**	**1**	**1**	**0**	**5**	**23**	**39 (45.35)**	**0**	**0**	**1**	**0**	**0**	**1 (1.16)**	**5**	**37**	**0**	**0**	**4**	**46 (53.49)**	**86**
	Specialty A	2	2	0	0	0	0	2	6	0	0	0	0	0	0	2	18	0	0	0	20	26
	Specialty B	2	1	1	1	0	5	10	20	0	0	1	0	0	1	1	5	0	0	0	6	27
	Specialty C	0	2	0	0	0	0	11	13	0	0	0	0	0	0	2	14	0	0	4	20	33
	Culture and sensitivity	**4**	**6**	**3**	**1**	**0**	**0**	**26**	**40 (62.50)**	**1**	**1**	**1**	**0**	**0**	**3 (4.69)**	**0**	**16**	**1**	**0**	**4**	**21 (32,81%)**	**64**
	Specialty A	4	1	0	0	0	0	6	11	0	1	0	0	0	1	0	14	0	0	1	15	27
	Specialty B	0	1	2	1	0	0	10	14	1	0	1	0	0	2	0	2	1	0	2	5	21
	Specialty C	0	4	1	0	0	0	10	15	0	0	0	0	0	0	0	0	0	0	1	1	16
	Infection markers	**1**	**2**	**1**	**0**	**0**	**0**	**8**	**12 (17.14)**	**0**	**0**	**0**	**0**	**1**	**1 (1.43)**	**2**	**55**	**0**	**0**	**0**	**57 (81,43%)**	**70**
	Specialty A	1	1	0	0	0	0	0	2	0	0	0	0	0	0	0	27	0	0	0	27	29
	Specialty B	0	0	0	0	0	0	6	6	0	0	0	0	0	0	2	10	0	0	0	12	18
	Specialty C	0	1	1	0	0	0	2	4	0	0	0	0	1	1	0	18	0	0	0	18	23
	Lines/invasive devices	**2**	**1**	**0**	**3**	**0**	**1**	**21**	**28 (46.67)**	**0**	**0**	**0**	**0**	**0**	**0 (0.00)**	**2**	**29**	**0**	**0**	**1**	**32 (53,33%)**	**60**
	Specialty A	1	1	0	2	0	0	8	12	0	0	0	0	0	0	0	16	0	0	1	17	29
	Specialty B	1	0	0	1	0	0	7	9	0	0	0		0	0	1	3	0	0	0	4	13
	Specialty C	0	0	0	0	0	1	6	7	0	0	0	0	0	0	1	10	0	0	0	11	18
Other discussions	**Treatment/ clinical information**	**6**	**26**	**0**	**0**	**3**	**44**	**28**	**107 (21.84)**	**7**	**2**	**0**	**0**	**2**	**11 (2.24)**	**19**	**347**	**1**	**1**	**4**	**372 (75.92)**	**490**
	Specialty A	4	9	0	0	0	0	6	19	3	1	0	0	0	4	8	197	0	0	1	206	229
	Specialty B	1	7	0	0	3	39	17	67	1	1	0	0	0	2	10	72	0	0	0	82	151
	Specialty C	1	10	0	0	0	5	5	21	3	0	0	0	2	5	1	78	1	1	3	84	110
Asking questions, planning and instructing patient care (key decisions)	**Asking questions**	**7**	**8**	**8**	**6**	**2**	**20**	**110**	**161 (90.45)**	**2**	**0**	**0**	**1**	**1**	**4 (2.25)**	**6**	**0**	**1**	**1**	**5**	**13 (7.30)**	**178**
	Specialty A	4	2	0	0	2	2	32	42	0	0	0	0	0	0	1	0	0	0	1	2	44
	Specialty B	2	2	6	5	0	10	46	71	1	0	0	0	0	1	3	0	1	0	0	4	76
	Specialty C	1	4	2	1	0	8	32	48	1	0	0	1	1	3	2	0	0	1	4	7	58
	Planning	**4**	**22**	**1**	**2**	**0**	**20**	**70**	**119 (73)**	**0**	**1**	**0**	**1**	**0**	**2 (1.23)**	**11**	**24**	**0**	**1**	**6**	**42 (25.77)**	**163**
	Specialty A	1	9	0	1	0	2	19	32	0	1	0	0	0	1	9	15	0	0	3	18	51
	Specialty B	1	4	0	1	0	16	27	49	0	0	0	0	0	0	0	3	0	0	0	3	52
	Specialty C	2	9	1	0	0	2	24	38	0	0	0	1	0	1	2	6	0	1	3	12	51
	Direct instructions	**0**	**2**	**3**	**8**	**0**	**0**	**5**	**18 (85.71)**	**0**	**0**	**0**	**0**	**0**	**0 (0.00)**	**0**	**2**	**0**	**0**	**1**	**3 (14.29)**	**21**
	Specialty A	0	1	0	2	0	0	4	7	0	0	0	0	0	0	0	0	0	0	1	1	8
	Specialty B	0	0	2	6	0	0	1	9	0	0	0	0	0	0	0	0	0	0	0	0	9
	Specialty C	0	1	1	0	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0	2	4
	Grand total	**28**	**72**	**17**	**21**	**5**	**90**	**291**	**524**	**10**	**4**	**2**	**2**	**4**	**22**	**36**	**510**	**3**	**3**	**25**	**577**	**1132**

*Specialty A includes sociogram data from cardiothoracic ICU ward rounds.
ICU, intensive care unit.

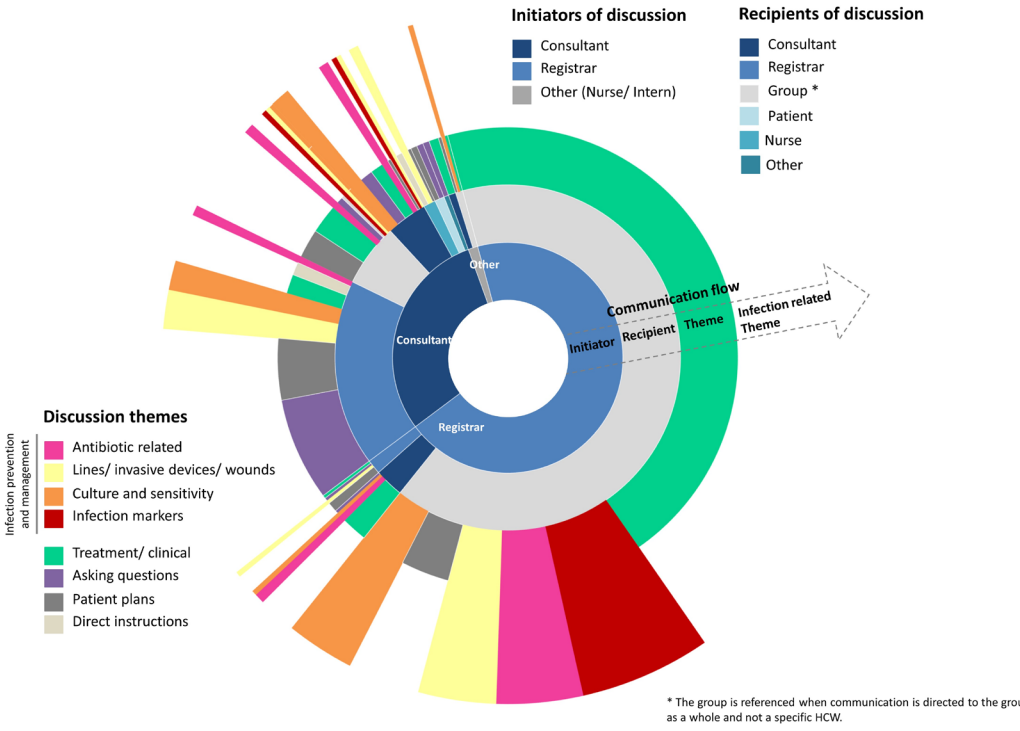


Figure 3 The direction and type of communication between ward round participants (initiators and recipients) of morning ward rounds in specialty A. This chart summarises data from 20 sociograms illustrating the hierarchy in flow of communication between the healthcare professionals present and the patient. Concentric rings correspond to a level in the hierarchy and are sliced in proportion to their value. The rings (from the inner to outer ring) represent initiators of communication; the recipients actively engaged in communication and the topics discussed including infection management. HCW, healthcare worker.

be directly assigned to an identified person, and direct verbal communication with nurses (and other members of the team) enables time-sensitive infection management (Q6, Q7, Q14, table 1, and figure 2 – sociogram 2). In contrast, verbal orders may be communicated in general to the group, and in some observations, the person who would be expected to enact the order was not present on the round. Positive direct interactions are consistently demonstrated by the same consultants and are illustrated by the counts of direct instructions from consultants to nurses and interns in specialty B (table 2). These interactions are noteworthy considering that nurses and interns enact most of the AMS and infection management orders that may include starting, changing or stopping antibiotic therapy or removing invasive devices or lines.

Consultants are the link between the patient and the ward round attendees and communicate with patients on surgical bedside rounds. Communication with the patients may happen at different points in the day, but on the ward round, interactions initiated by the consultant range from a simple greeting to a short phrase to communicate updates or next steps, through to engaged and inclusive communication where the patient's participation is invited (Q15, table 1). Levels of engagement are linked to the individual leadership style of the consultant. Details on infection management are seldom communicated with patients; however, some consultants, regardless of time pressures, consistently relay the plan, which includes antibiotic treatment and infection management to the patient (Q16, table 1, and figure 1).

DISCUSSION

In this study, we used sociograms to describe team dynamics related to antibiotic prescribing and monitoring and infection management in surgical teams. Sociograms provide a unique way to map interactions at the patient bedside and provide effective and real-time visual depictions related to communication and team dynamics. Adopting sociograms in this study served to triangulate the rich narrative of descriptive and contextual data provided by observations and interviews, effectively highlighting team interactions that were more difficult to describe using traditional data collection methods. The new insights provided describe how information on infection management and AMS is initiated; who leads (and is engaged in) the conversations around infection prevention and management; who makes decisions and how decisions are communicated with those who must enact them; and where HCWs position themselves around the bed space that can be a reflection of their role in the team and their contribution to the ward round.

Similar to other settings, communication on ward rounds remains largely between consultants and registrars, excluding nurses and other HCWs.[24 40] Due to resource limitations, pharmacists do not attend the

surgical rounds. An unrealised potential exists for nurses to have an active role in AMS and infection prevention and management to prompt antibiotic review, especially intravenous to oral switch, as well as to monitor for adverse drug effects.[41] The sociograms identified that where members of the team position themselves on the round is predictor of their participation. Although not everyone is expected to contribute equally, discussions predominantly engage members who are physically and figuratively in the middle (generally consultants and registrars). Remaining mostly on the outer boundaries, nurses face communication limitations and are not always fully engaged in the decision making. This is despite the critical information that they could provide to patient care. Proactive engagement of key role players by the person leading the ward round has the potential to facilitate more effective ward round communication and participation. We observed this on rounds led by consultants who were more proactive in identifying and engaging with the wider team, including nursing staff present, to assign tasks and actions identified during the round.

While routine discussions on infection management did take place, high patient numbers and time pressures meant that antibiotic de-escalation and discontinuation, and removal of venous and urinary catheters, were less likely to be discussed during ward rounds. Indeed, ensuring discontinuation of unnecessary antibiotics remains the most common recommendation in AMS interventions.[42] Studies have shown that in the absence of the full team compliment or if decisions are not communicated to the pertinent role player, potential time delays can have an impact on patient outcomes.[43]

Lack of standardisation has been noted in other surgical teams[19 44 45] where key aspects of care may be overlooked and is associated with suboptimal patient outcomes.[46] Patterns of handover are not standard across specialties and even differ between registrars in the same specialty. Key factors relevant to infection prevention and management and AMS are sometimes not consistently highlighted by registrars in the initial update, as noted in earlier studies.[5 6] Structured checklists and handover sheets have been noted to ensure discussion of important clinical information on ward rounds, leading to improved team communication and documentation and patient safety, while also significantly reducing 7-day readmissions.[16 18 19 47 48] By following a specified format on patient update in one specialty, registrars delivered clear and regular information on infection management. Such communication has been noted to reflect a transparent culture of safety and best practice.[46] The absence of a structured handover tool sometimes means that delivery of care is influenced by factors such as high patient volumes and rushed ward rounds,[18 48] various handover and leadership styles by registrars and consultants, other surgical priorities and the rotation of registrars through specialties.[46 49] In addition, inconsistent provision of clinical and infection-related information in the update can result in loss of valuable time, limiting the ability for generating relevant and correct information.[50] Despite the increasing threat of antibiotic resistance and HCAIs, it is interesting to note that few of the existing checklists, other than those designed for dedicated AMS rounds,[42] alert a surgical team to the key aspects of AMS and infection prevention and management. An opportunity exists to apply AMS and IPC principles to every single patient on every ward round and should not be reserved to dedicated stewardship rounds only. Gilliland *et al*[48] reports that AMS documentation went from 0% to 100% following the introduction of a ward round template.[48] In another study, the implementation of a ward round checklist increased checks of invasive devices from 9% to 72%.[18]

The key learning from this paper relates to patterns of communication and teamwork focused on AMS and infection management across surgical teams. Visually mapping communication has highlighted interesting team dynamics including varied leadership styles; unequal contributions by team participants who have critical and different roles in AMS and infection prevention and management; and diverse but overall limited interactions with patients on the ward round. Based on these findings, recommendations for interventions to optimise teamwork and communication on AMS and infection management are listed in figure 4.

1. **Team involvement** - Use a formalised team- based approach to improve team dynamics on ward rounds, ensuring explicit involvement of all key players, including nurses and pharmacists, in discussion of antibiotic prescribing and infection prevention and management. This could include ensuring that key players are physically located to be able to hear and contribute to discussions and having prompts to remind consultants to invite the views of nurses and other members of the ward round group.
2. **Standardising handover** – Develop a mechanism to consistently include AMS and infection management information in handover; document standard information relating to AS and infection management in doctors' notes.
3. **Integrating AMS into routine care** – Include discussion about antibiotic prescription and infection management at different specified touch points throughout the day, as well as streamlining/ clustering communication on AS and infection management at a dedicated ward round.
4. **Prioritising infection management on rounds** – To 'Flag'/alert AMS and infection management related principles on every round with every patient, using a structured approach similar to WHO surgical checklist, or an acronym-based approach, for example, a quick, standard 30-second check in on a few points: Antibiotics (type, number of days, de-escalate); Lines (type, number of days); Invasive devices (type, number of days); Investigations (results etc); Infection Markers (results); Contact/ airborne/ droplet precautions.
5. **Applying sociograms/ visual mapping as a tool to prompt team reflexivity** – To provide team members with a space and opportunity to discuss visual images tracking their team dynamics and communication as captured by sociograms. It is anticipated that reflexivity will enable the team to identify individual communication practices and the effect on the team dynamics within the context of the individual ward.

Figure 4 Recommendations for interventions to optimise teamwork and communication on AMS and infection management. AS, antibiotic stewardship; AMS, antimicrobial stewardship.

Visualising active participation is a key contribution of the methodology described in this study. In addition to methods such as video reflexive ethnography, sociograms may offer a tool to prompt team reflexivity. Reflexivity enables a team to focus on individual and team practices taking social and contextual information into account and has been used in healthcare settings to effect change in teamwork and interprofessional communication.[26 51–53] Visual mapping exercises can provide insight into prevailing practices and can be used reflexively to improve communication and team dynamics, particularly supporting greater involvement of the wider healthcare team in decision making.

Leadership and its influence on team dynamics are highlighted but require more in-depth study, and given that communication skills and team work are two of the five key areas that contribute to successful ward round leadership,[54] findings from this study may offer learning for developing a framework to enhance participatory leadership on ward rounds. In a process of reflexive learning, teams can analyse leadership practices captured in real time and also consider and explore examples of inclusive leadership practises.

Limitations

This was an observational study and provides a visual snapshot of interactions on infection management and AMS from a single study site, and therefore, the findings may not be generalisable to other settings. The methods we adopted can however be applied in other settings to collect comparable data. In this study, observations were limited to consultant-led morning ward rounds. As such, other opportunities for communication around patient care may have been missed. Consultants convey that surgical teams use multiple informal opportunities[55] during the day to update and adjust patient plans in response to infections, and therefore, the morning round is not a complete reflection of all communication on AMS and infection management. The morning ward rounds however, remain a key opportunity for multidisciplinary interactions. Though we did not have ethical approval to study gendered and racial factors that may have influenced the observed practices, the emerging data indicate that, indeed, it is essential to investigate team dynamics and communication through intersectional inquiry. Future studies, with appropriate design and representation, need to investigate the effect of social constructs such as gender, race and ethnicity on team dynamics and decision making in the clinical environment.

CONCLUSIONS

The surgical bedside ward round, though attended by many specialties, remains a medium of communication between registrars and consultants, with little interaction with the patient or other healthcare professionals. A more team-based approach[56] characterised by the shared understanding and value of each team member's roles and responsibilities in relation to antibiotic prescribing and infection management could result in better communication and effective decision making.

Sociograms enabled data triangulation and validation and were a powerful visual illustration giving participants a global view of the interaction, flow and team dynamics on ward rounds. Furthermore, they provided insight into how some existing gaps in communication could be addressed. Sociograms may provide an opportunity for reflexive feedback to improve team dynamics and communication.

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Acknowledgements The authors wish to thank all the members from the University of Cape Town (UCT) Antimicrobial Stewardship (AMS) Surgical and Cardiothoracic ICU Teams/Study Group for access to their teams, research support during data collection and for their collaboration and positive contributions to the development of the work and this manuscript. We wish to acknowledge the nursing teams and pharmacists for their support and also convey a special thanks to Christine Woods for her helpful assistance with the quantitative analysis.

Collaborators Groote Schuur Hospital Antimicrobial Stewardship and Surgical Study Group: Ms J Abrahams, Professor B Biccard, Professor A Brink, Ms Brits, Dr C Centner, Professor S Dlamini, Dr B Eick, Mr E Nywagi, Ms G Joosten, Dr JP Kloppers, Dr A Kruger, Dr M Miller, Mr A Mohamed, Ms V Morris, Ms V Naicker, Dr B Nkgudi, Professor E Panieri, Dr J Piercy, Dr E Prentice, Dr R Manganyi, Dr N Samodien, Dr E Scout, Professor J Sherman, Dr D Thomson, Professor S Wasserman and Professor P Zilla.

Contributors MM, AH, EC and CT contributed to protocol development and design of the study. EC led the study and EC, CB and OM collected data. MM, AB, MH, SR and TP enabled access to the teams and the study site. EC, CB, OM, MM and CT contributed to data analysis and write up of this manuscript. All authors critically revised the content of the manuscript. All authors and collaborators read and approved the final version.

Funding This study was supported by National Institute for Health Research, UK Department of Health in partnership with Public Health England, Economic and Social Research Council.

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval Ethical approval was obtained from the University of Cape Town Human Research Ethics Committee (Ref: 499/2018).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement All data relevant to the study are included in the article or uploaded as supplementary information.

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